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Asymptotic behavior of the error between two different Euler schemes for the Lévy driven SDEs

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We study the Multi-level Monte Carlo method introduced by Giles [3] and its applications to finance which is significantly more efficient than the classical Monte Carlo method. This method for the stochastic differential equations driven by only Brownian Motion had been studied by Ben Alaya and Kebaier [2]. Here, we consider the stochastic differential equation driven by a pure jump Lévy process. When the Lévy process have a Brownian component, the speed of convergence of the multilevel was recently studied by Dereich and Li [4].

Now, we prove the stable law convergence theorem in the spirit of Jacod [1]. More precisely, we consider the SDE of form
\begin{equation}
X_t=x_0+\int_0^t f(X_{s-})dY_s, (1)
\end{equation}
with $f \in \mathcal{C}^3$ and Y is a Lévy process with the triplet $(b, 0, F)$ and look at the asymptotic behavior of the normalized error process $u_{n,m}(X^n - X^{nm})$ where X^n and X^{nm} are two different Euler approximations with step sizes $1/n$ and $1/nm$ respectively. The rate $u_{n,m}$ is an appropriate rate going to infinity such that the normalized error converges to non-trivial limit. Under some different assumptions on the properties of the Lévy process Y in (1), we found different suitable forms of the rate $u_{n,m}$.

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